

Interference-free LMS-based adaptive asynchronous receiver

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**FIELD OF THE INVENTION**

The invention generally relates to digital transmission and recording systems. In particular, it relates to a receiver for delivering a data sequence  $a_k$  at a data rate  $1/T$  from a received sequence  $r_n$  sampled at a clock rate  $1/T_s$ , asynchronous to the data rate  $1/T$ .

5        The invention also relates to a digital system comprising a transmitter for transmitting a digital sequence via a channel and a receiver for extracting said digital sequence from said channel, wherein said receiver is a receiver as described above.

The invention further relates to an equalizer adaptation method for said receiver. It finally relates to a computer program product for such a receiver and to a signal for carrying said

10      computer program.

The invention applies to a wide variety of asynchronous receivers for use in digital transmission and recording systems. It is particularly advantageous in high density / capacity optical disc systems such as the Blu-ray Disc system (BD).

15      **BACKGROUND ART**

US patent n° 5 999 355 describes an asynchronous receiver such as the one mentioned in the opening paragraph. In accordance with the cited patent, the equalizer is a tapped delay line (Finite Impulse Response filter) with a tap spacing of  $T_s$  seconds. Control of the equalizer is based on the classical LMS (Least Mean Square) algorithm; that is to say,

20      correlating the tap sequences with a suitable error sequence produces updates of the equalizer tap values. Classical LMS techniques normally apply to synchronous receivers wherein error and tap sequences have the same sampling rate and are phase synchronous. The asynchronous receiver described in the cited patent thus comprises at least two provisions in order that error and tap sequences have the same sampling rate and are phase synchronous.

25      The latter condition implies that any latency in the error sequence should be matched by delaying the tap sequences accordingly. The aforementioned two provisions include an inverse sampling rate conversion (ISRC) for converting the synchronous error sequence at the data rate  $1/T$  into an equivalent error sequence of sampling rate  $1/T_s$ . The receiver, having an asynchronously placed LMS-based adaptive equalizer, has two control loops: a